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An analysis of the factors affecting the net operating result at Naval Aviation Depot Cherry Point, North Carolina

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THESIS

AN ANALYSIS OF THE FACTORS AFFECTING THE NET OPERATING RESULT AT NAVAL AVIATION DEPOT CHERRY POINT, NORTH CAROLINA

by

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December 2002

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AN ANALYSIS OF THE FACTORS AFFECTING THE NET OPERATING RESULT AT NAVAL AVIATION DEPOT CHERRY POINT, NORTH CAROLINA

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This thesis explains the current process involved in establishing stabilized rates for the Naval Aviation Depot (NADEP) Cherry Point, North Carolina. Existing data were examined to aid in understanding the process for determining stabilized rates, workload standards, and workload allocation. Additionally, this research provides an analysis of the inputs to the rate setting process to determine which has the most influence on the financial operating result. A general history of working capital funds is provided and an explanation of the financial and management goals of the Navy Working Capital Fund are spelled out. An assessment of existing methods was based on variance analysis between projected results and actual results. The variance analysis suggests that the current methods used for determining workload standards consistently underestimate the number of hours required to complete the work. Finally a sensitivity analysis was conducted to determine which input variable has the most influence on the net operating result. The sensitivity analysis suggests that changes to workload norms have the most influence on the bottom line at the NADEP.

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I. INTRODUCTION

A. PURPOSE

The purpose of this research is to provide an understanding of the current process involved in establishing stabilized rates for Naval Aviation Depot (NADEP) Cherry Point, North Carolina. Additionally, this research will provide an analysis of the inputs to the rate setting process to determine which has the most influence on the operating result.

B. BACKGROUND

The mission of the NADEP is to provide responsive worldwide maintenance, engineering, and logistics support to the Fleet. Additionally the NADEP maintains a core industrial resource base for the Department of Defense (DoD), which is essential for mobilization [Ref 1]. Organizationally, the NADEP is nested within Navy Depot Maintenance that also includes shipyards and Marine Corps depots. Navy depot maintenance is just one part of the overall Navy Working Capital Fund (NWCF). Historically the U.S. has had two broadly defined types of funds, stock funds and industrial funds. Stock funds were essentially involved with supply and material management; whereas industrial funds provided for depot maintenance, transportation, and research and development [Ref 1]. Revolving funds are primarily financed through sales revenue by reimbursements from customers' appropriated accounts as opposed to direct appropriation. DoD established the Defense Business Operations Fund (DBOF) in

1991 as a means to expand businesslike financial management practices within the department and achieve full cost visibility. DBOF combined the existing stock and industrial funds into one fund. Then, in 1996 the Under Secretary of Defense, Comptroller (USD(C)) disestablished the DBOF and created four separate funds in its place. Currently, each service has a working capital fund. There is also one defense-wide working capital fund and the Defense Commissary Agency. The cancellation of DBOF put the management responsibility back on the components for both functional and financial aspects of their activities [Ref 2 page 50-5].

WCFs recover all costs including direct costs, indirect costs, General and Administrative (G&A) costs, and any prior year gains or losses through stabilized billing rates charged to customers. The goal of each WCF is to operate on a break-even basis over time. However should a profit or loss occur, the WCF would either lower, or raise, the billing rate in a subsequent year to realize sufficient revenue to cover costs and neutralize the profit or loss. The term “Net Operating Result” (NOR) is the annual profit or loss that resulted from the preceding year of operations. The NOR is a function of the stabilized rate, actual workload, and labor efficiency. The long-term accumulation of the net operating results is called the accumulated operating result (AOR). Each year business activities strive to attain a break even AOR by adjusting rates based on the anticipated workload, and the previous year’s NOR. Profits in one year result in rebates to customers in the next year in the form of lower rates whereas losses have the opposite effect.

C. RESEARCH QUESTIONS

The following questions were addressed during this research:

1. Primary:

Which of the three main input variables (stabilized rates, workload standards, or workload allocation) has the most influence on the outcome of the net operating result?

2. Secondary:

(1) How effective are the current models at achieving the desired results?

(2) Where should management focus its attention to get the most return on effort?

(3) Can existing data be used to develop a new forecasting model?

D. SCOPE OF THESIS

Existing data were examined to understand the process for determining stabilized rates, workload standards, and workload allocation. An assessment of existing methods was based on the projected results versus actual results. Finally a sensitivity analysis was conducted to determine which input variable has the most influence on the net operating result.

E. RESEARCH METHODLOGY

The methodology used in this thesis research consisted of literature reviews, interviews, historical data

collection and analysis, and evaluation of existing methods.

(1) Literature review: A literature review was conducted including DoD policy publications, General Accounting Office (GAO) reports, previous theses, and DoD budget material. The emphasis of the review concerned policy, rate setting processes, and general performance difficulties at depot maintenance activities.

(2) Interviews: Interviews were conducted with budget analysts at the Navy Comptroller level to get a broad perspective on how NADEPs fit into the overall NWCF picture. Then interviews were conducted with industrial competencies at the Naval Air Systems Command (NAVAIR) to get a finer level of detail on the rate setting process and to see how NADEP Cherry Point fits into the overall NADEP picture along with Jacksonville and North Island. Finally, interviews were conducted at NADEP Cherry Point to get the specific level of detail to see how Cherry Point manages the rate setting process, the workload standard process, and the changes from the plan to actual workload allocation. Interviews at Cherry Point included a tour of the facility to help understand the magnitude of the operation and the level of detail required to make quality projections.

(3) Historical data collection and analysis: Data were collected and analyzed for the three most recent complete years (FY 99, 00, and 01) on planned workload standards compared to actual hours to complete work, and on the rates submitted compared to the final stabilized rates approved, and on projected workload allocation compared to

the actual work that materialized. These data were collected in four specific arenas, H-46 and H-53 helicopters and T-58 and T-64 turbine engines.

(4) Evaluation of existing methods: Existing methods were evaluated simply by comparing forecasted outcomes and actual outcomes. The data were analyzed to determine if there was any pattern in the variance, either cyclical or long term trend that could be used to develop a better model to predict NOR.

F. SUMMARY

The intent of this chapter was to introduce broad topics and give the reader a general perspective on the scope of the research. The following chapter details the history and goals of WCFs and explains why and how changes have been made over the past several years.

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II. OVERVIEW OF WORKING CAPITAL FUNDS

A. HISTORY

Title 10 USC section 2208 authorizes the Secretary of Defense to establish working capital funds (WCF) for industrial type activities. WCF’s are revolving accounts and get their name from the circular flow of funds that replenish the initial working capital, called a corpus. The corpus is established through an appropriation or transfer from an existing revolving account and is used to finance the initial cost of goods and services. Customers place orders and the WCF finances the work to complete the order by drawing down the corpus. Then the customers get billed for the work based on the stabilized rate set for the goods and services. Finally, the customers remit payment from their appropriated funds to replenish the working capital [Ref 2 page 50-1].

Prior to 1991, there were nine working capital funds within the DoD, four stock funds and five industrial funds. In 1991, the Defense Business Operations Fund (DBOF) was established by consolidating the existing nine funds along with several appropriated fund support activities [Ref 3 page 11]. In 1996, the Under Secretary of Defense (Comptroller) reorganized the DBOF and created the four working capital funds that we have today. In 1997, a separate working capital fund was established for the Defense Commissary Agency. This thesis is specifically concerned with NADEP Cherry Point within the Navy Working Capital Fund.

B. GOALS

1. Management

The main management objective of the NWCF is to achieve full cost visibility and total cost recovery for the business operations that the Navy conducts. Full cost visibility allows managers to focus attention on the total cost of DoD business functions and promote active cost management [Ref 1]. Some further management objectives according to the Navy Comptroller Manual volume five are to provide managers incentive to improve cost estimating and cost control through the use of cost standards and contractual relationships between producers and ordering agencies. Additionally, the NWCF provides authority and flexibility required to procure and use manpower and other resources effectively by encouraging cross servicing among military departments for more economical use of facilities.

2. Financial

The financial objective of the NWCF is to break even over the long term meaning there is neither financial profit nor loss [Ref 2 page 50-2]. Through customer billing the NWCF is expected to recover the total cost of operations including overhead and general and administrative expenses. Labor, material, and overhead rates are negotiated based on predicted workload and costs in order to achieve the goal of a zero Net Operating Result (NOR) over time. Since rates are determined based on predictions, the invariable changes to the plan result in either higher or lower than expected revenue. The resultant profit, or loss, is corrected the following year by adjusting customer billing rates lower or higher.

C. SUMMARY

Working capital funds have been in existence since the late 1940’s and have changed many times in the last fifty years. Through the years, and particularly recently, the budget has been getting tighter and Secretaries of Defense have increasingly been more interested in getting larger bang for the buck. As a result, the DoD revolving funds have transformed more over the last decade than in the previous fifty years. Since 1991, stock and industrial funds were combined with appropriated support activities to form the DBOF, and then in 1996, DBOF was devolved back into separate funds for each service and one defense wide working capital fund. In 1997, the Defense Commissary Agency became its own separate WCF. The current structure is comprised of the Navy Working Capital Fund, the Army Working Capital Fund, the Air Force Working Capital Fund, the Defense-wide Working Capital Fund, and finally the Defense Commissary Agency. These changes seem to be in congruence with the management goals that were discussed previously. The working capital fund concept itself does not save money, instead it increases cost visibility, which gives managers the flexibility to control costs, increase efficiencies, and make informed budget decisions [Ref 1].

The next chapter examines some detailed factors affecting the bottom line at the NADEP including the rate setting process along with describing how workload projections are made and the process of determining workload norms.

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III. FACTORS AFFECTING OPERATING RESULTS

A. INTRODUCTION

Prior to fiscal year 1975, depots were allowed to adjust the prices charged to customers quarterly for cost increases. Frequent changes made it difficult for appropriated fund customers to execute their budgets effectively due to the uncertainty of the costs associated with the work. Rate stabilization was established in 1975 to protect customers from cost uncertainties. The intent of the policy was to ensure customers would not have to reduce programs during the year of execution due to higher than expected prices. In turn, this allowed customers to provide more reliable estimates to providers. Ultimately, this should result in better planning for the efficient use of WCF resources [Ref 4 page 3].

DWCF Rate setting is grounded in the DoD Planning, Programming, and Budgeting System (PPBS). In order for the WCF financial structure to work as intended, customers must be provided with resources to purchase good and services from providers. At the same time, providers must, in anticipation of orders, have the authority to incur costs to provide goods and services to the customers. The PPBS is used to justify customer resource requests and provides the needed authority for WCFs to incur costs. In the planning phase of the PPBS, managers try to determine the nature and amount of infrastructure needed to support the DoD requirements. Then during the programming phase resources are matched against validated requirements in the form of the Program Objectives Memorandum (POM).

Customers, within resource constrained guidance, specify the appropriated funds they anticipate needing to purchase goods and services from the WCF. This “anticipated demand” is the basis for determining the size and makeup of the workforce, capital investment projects, and inventory levels. During the budget formulation, components are responsible for balancing WCF budgets with the customers’ appropriated fund requirements [Ref 5 chapter 3]. The Stabilized rates are established through the budget process based on anticipated workload and estimated costs. The stabilized rates are designed to ensure that customers pay for the true full cost of goods and services they receive from the providers. Although rates are determined to recover the total cost of operations including labor, production overhead, and G&A overhead, there are two areas considered overhead that are not financed through customer rates. Specifically, the costs to maintain a surge capacity and the costs to procure and maintain war reserves or other capabilities required to meet an operational contingency are reimbursed from a direct appropriation [Ref 6 page 9-10].

The essence of rate stabilization is that rates are set for the entire fiscal year. The approved rates are used as the basis for each customer’s appropriation. Additionally, the policy of rate stabilization protects customers from unforeseen changes in costs, which in turn allows for more accurate planning and budgeting for WCF support requirements. In other words, this policy should reduce the fluctuations in planned work and permit more effective utilization of resources [Ref 1].

In order to start from a common foundation the next section will define some general terms.

B. DEFINITIONS

These general definitions will serve to remove ambiguity and are necessary for common understanding of the process described following this section.

Recall from previous discussion that the Accumulated Operating Result (AOR) is the accumulation of successive years Net Operating Results (NOR). Recoupment is a factor added to the stabilized rate to achieve zero AOR in the following year. For example, suppose for the previous year the AOR was negative meaning the activity had a financial loss carryover from previous years. Once the appropriate rate is determined that achieves a projected zero NOR for the current year, some recoupment factor is added to the rate to compensate for the prior year loss and consequently bring the AOR to zero as well. Surcharges are also added to break-even rates to finance capital investments and other extraordinary items.

A Direct Labor Hour (DLH) refers to all work physically performed and traceable to a specific job. DLH includes hands-on maintenance, repair, overhaul, and testing, etc. that can be directly traced to a unit output. It does not include supervisory work or other support or indirect labor, which instead are included in overhead expenses [Ref 6 page 9-27].

Workload is the actual amount of orders that are worked by an activity. Anticipated workload is one of the most important variables in the process of setting billing

rates. A workload standard is the average number of DLHs that should be required to perform a given task. The workload standard is negotiated annually and is based on both historical data and engineering standards developed using time, method, and motion studies for typical work. The stabilized rate is the final adjusted and approved cost per DLH that customers are charged for goods and services. In the case of fixed price work, which is the majority of business at NADEP Cherry Point [Ref 7], multiplying the workload standard by the stabilized rate then adding the standard material cost results in a firm fixed price for a given product or service.

C. RATE SETTING

The process for establishing stabilized rates generally begins about two years before the rates go into effect. Managers develop workload projections based on customer input. They use the projections to (1) estimate the number of people they will need to accomplish the work, (2) prepare a budget that identifies expected labor, material, and other costs, and (3) develop rates that, when applied to the expected workload, allow them to recover full costs from the customers [Ref 8 page 7]. Because rates are based on expected costs and workload, higher than expected costs or lower than expected customer demand can cause the WCF to incur losses.

Program rates are based on full cost recovery that includes direct labor rates, production overhead expense rates, G&A overhead expense rates, surcharges, recoupment, and adjustments.

Labor rates are developed in three steps. First, an acceleration rate is calculated that recognizes the costs of leave and fringe benefits. Labor acceleration is provided from the DoD Comptroller and is applied as an across the board percentage to all hours worked. Second, historical average hourly rates, adjusted for anticipated promotions, raises, and step increases are determined and used as a baseline. Finally program labor rates are computed by multiplying the labor acceleration by the baseline, the product is then divided by the labor hours allocated and the result is the program’s labor rate. The number of labor hours allocated is simply the product of the workload standard and the volume of anticipated workload.

Production overhead rates are developed for each production work center and may include indirect materials, indirect contractual services, indirect labor, and depreciation expense. The estimated production overhead expense divided by the total allocated hours equals the production overhead rate per each DLH for each program. Production overhead expense rates may be different for each program.

The G&A overhead rate is a single rate developed for all cost centers and spreads the estimated G&A expense to all direct work performed. G&A can include all material, contractual services, civilian labor, depreciation, and other expenses that occur in a G&A cost center. The G&A rate is the total estimated G&A expense divided by the total allocated DLH for the entire activity.

Recoupment is a factor added to the rate to neutralize prior year gains or losses from operations. If there were prior year gains, the recoupment could be negative which would result in a lower rate for customers. Surcharges are added to the rate in the current year to finance periodic or extraordinary expenses in future years such as large capital investments, or regulatory compliance items etc [Ref 9].

From the calculations mentioned above, each program gets a stabilized program rate, which is the sum of labor rates, production overhead rates, G&A rates, recoupments, surcharges, and adjustments for each program.

D. WORKLOAD

1. Projections

As mentioned in previous discussion, customers estimate anticipated workload and provide those projections through the budgeting process. In laymen's terms, NAVAIR works with the Type Commanders and the expected appropriated budget to predict what work will need to be accomplished. NAVAIR and the Type Commanders reach a balance between what needs to be accomplished and what they can reasonably afford [Ref 10]. As with all budgeting functions, workload is forecast as an intricate mix of requirements and resources. WCF managers use the projections to estimate the labor force and infrastructure requirements to meet the anticipated demand. Accurate workload projections are essential for the WCF because the anticipated demand drives so many of the factors that affect NOR. Anticipated customer orders affect anticipated

staffing, anticipated infrastructure requirements, and anticipated cost and mix of materials. Rates are developed from the anticipated DLHs, which is the product of the workload standard and the anticipated workload.

2. Allocations

NAVAIR's goal in allocating workload to the NADEPs is to provide the fleet what it needs to the maximum extent possible within the resource constraints they have [Ref 10]. The NADEP has no control over the induction rate or the volume of work that materializes. They do their best to forecast based on historical data or known requirement changes. Spikes in workload are first handled with overtime, if the work can be completed with less than ten percent of the amount budgeted for overtime, otherwise contractors are brought in to cover the requirements for direct labor during the spike period [Ref 7].

If actual workload is less than projected, then either artisans shift to an area where they are less skilled and therefore less efficient or direct labor becomes indirect labor. The result is either workload standards will not be met or the rate was set too low to recover increased overhead costs. In addition because of the sheer volume of workload, deviations in workload mix lead to skill level inefficiencies, inventory problems and possible bottlenecks in production flow. Deviations from plan in workload volume involve rate, or price, variances, whereas deviations in workload mix involve workload standard, or efficiency, variances.

E. WORKLOAD STANDARDS

Workload standards are the normal expected direct labor hours that it should take to complete a specific task. Engineers at the NADEP using historical performance data, as well as documented engineering standards using time, method, and motion studies assign the standards. NAVAIR validates and approves the engineering studies performed by the NADEP. Workload standards are a key component in the whole process because the standards are the basis that NAVAIR uses to provide funded hours to the NADEPs and funded hours are one factor used in determining stabilized rates. The employees interviewed at both the NADEP and NAVAIR were extremely confident in the validity of the engineering standards and the algorithm used to develop the workload standards.

F. SUMMARY

Since the majority of work at Naval Aviation Depot (NADEP) Cherry Point is fixed price work, the process of setting stabilized rates is extremely important for attaining the NOR goal. Other factors that influence NOR are the ability of management to reliably predict expected workload and cost of materials. Still another variable is the efficiency of the workforce measured by how closely actual labor hours compare to the standard hours called workload standard. The rate setting process is very involved and each variable is dependent on the other in some fashion.

There are many moving parts that need to be coordinated in order to achieve the desired operating goal

at each NADEP. WCF managers have the responsibility to take input from various sources, apply algorithms to account for historical performance and future uncertainty, and come up with a rate that they think will facilitate achievement of the desired operating result. The stabilized rate along with the negotiated workload standard and the actual workload determine the activity’s NOR.

Now, with an understanding of the current process involved in establishing stabilized rates at NADEP Cherry Point, in the next section we will conduct an analysis of the results at Cherry Point in four areas. CH-46 and CH-53 helicopter work and T-58 and T-64 engine work.

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IV. DATA COLLECTION AND ANAYLSIS

A. INTRODUCTION

The primary data were collected by two principal means consisting of interviews with various employees from NADEP Cherry Point, NAVAIR, and the Navy Comptroller’s Office of Budget, as well as financial results and figures collected from NADEP Cherry Point.

The interviews were conversational in nature and were used to get a general feel of what the people from different parts of the organization perceived as the key variables that affected operating results. There was an overwhelming consensus that the engineering studies provided accurate and realistic workload norms. This sentiment was echoed at both the NADEP and NAVAIR. The NADEP cited two chief issues that made it difficult for them to meet the desired NOR targets: firstly, workload allocation being significantly less than original projections and secondly, workload mix being significantly different from that which was projected. Since rates were based on projected workload, if the expected volume of work did not arrive, then the rates would be too low to recover all the expenses. Along those same lines, if a particular skill set of artisans was hired in anticipation of work, but a different mix of work arrived, then it would seem that labor inefficiencies would certainly exist.

The NADEP provided historical data from fiscal years 1999, 2000, and 2001. The data included a detailed breakout of billing gain or loss on each job order number for CH-46 and CH-53 helicopters as well as for T-58 and T-

64 engines. These spreadsheets included workload norms versus actual hours, standard versus actual material costs, the approved rate and fixed price for each job. Each spreadsheet also included actual costs for labor, production overhead, G&A, and an “other costs” category. The other cost category includes contractor direct labor hours for each job order. Billing rates were also provided that broke the stabilized rate into its component parts such as direct labor, production overhead, G&A overhead, recoupment, surcharge, and adjustment. Finally workload projections and actual execution figures were provided for the volume of work accomplished. Refer to Appendix A. for a representative snapshot of the actual data that were provided for this research. The scope of this thesis was to look only at workload norms, workload projections / allocations, and stabilized rates. Factors of the NADEP’s revenue that were not affected by changes to these variables, namely material costs and any surcharges, recoupments, or adjustments; were therefore removed from the actual data before any analysis was made.

B. DATA MANIPULATION

The data were normalized to isolate all the variables that were beyond the scope of this research. The billing gains and losses were manipulated to delete the influence of material costs and any surcharge or recoupment factors. The allowed standard material costs were deducted from the actual revenues while at the same time the actual cost of materials was taken out of the expense category. Additionally, all surcharges, recoupments, and adjustments

were cut out of the stabilized rate and the cumulative contribution of these factors was taken out of the billing gain or loss for each job. Ultimately the “approved stabilized rate” for each fiscal year used in the calculations was simply the sum of the approved direct labor rate, the production overhead rate, and the G&A rate. Consequently, revenues were counted as the product of the normalized approved rates multiplied by the approved workload standard for each job order number. The financial gain or loss for each job was determined by the difference between this new revenue figure and the actual costs for labor, overhead expense and G&A expense. The effect of manipulation of the data was that the only variables used in the determination of the billing gain or loss were the variables of interest to this thesis. Refer to Appendix B. to see a representative snapshot of the data used in the calculations. In order to analyze which of the input variables (workload projection, workload standards, or rate setting) had the most influential affect on the net operating result, a sensitivity analysis was conducted.

C. SENSITIVITY ANALYSIS

1. Definition

Sensitivity analysis is a method of determining how much an outcome will change in response to a given change in an input variable when all other things are held constant. The analysis begins with a base case scenario, which for this research was the actual billing result using actual workload norms, actual workload volume projections, and the actual stabilized rates. Each variable was then

changed above and below the actual value and a new billing result was projected using these changed values for the input variables. Finally the set of billing result values were plotted against the variable that was changed. The slope of the line indicates the relative sensitivity of the outcome to the changed variable; the steeper the slope the more sensitive the outcome is to changes in that variable. [Ref 11]

2. Process

The three variables that were analyzed were workload norms, workload projections, and stabilized rates. The data that were provided by NADEP Cherry Point were used as the basis for all calculations. Using the hypothesis that approved rates are based on projected workload norms from the A-11 budget submission, for this analysis, workload norms were taken from the NWCF A-11 budget submission for each fiscal year provided by the NADEP. These norms were increased and decreased by ten percent for the sensitivity analysis.

Workload projections, or estimated volume, also came from the NWCF A-11 budget submission for each fiscal year. To get the annual projected workload, the quarterly induction projections were added for each fiscal year ignoring carry in and carry out figures. The rationale for ignoring carry in was that those jobs were accounted for in a previous fiscal year therefore the revenue received did not contribute to the operating result in the current year. Additionally, in general the NADEP was in dynamic equilibrium, meaning that net inflow was equal to net outflow so actual inductions were equal to the amount of

work completed in each fiscal year. Some job order numbers were labeled as outliers and not included in the calculations if the figures provided could not be duplicated. In that case, the actual volume of work for calculation purposes differed from the execution figures provided by the NADEP. The workload projections were decreased by the same percentage as the reduction in execution so as not to overly influence the workload allocation computations. For example, if workload execution was actually 30 units but only 28 units were used for the calculations, then the original workload projection was multiplied by 28/30 to keep the proportional difference between actual volume and projected volume the same. The workload projections were increased and decreased by ten percent for the sensitivity analysis.

Stabilized rates are a function of both the workload projections and the workload norms. A method was needed for determining new rates based on changes to either workload norms or workload projections. In order to determine what rates would have been, given a change of ten percent in norms and workload projections, a model was needed to predict production overhead (OVHD) and G&A expense (G&A) based on projected hours.

A technique called regression analysis was used, which tries to quantify the relationship between two or more variables. Generally regression is used to describe the value of the dependent variable on the basis of one or more independent variables [Ref 12]. For this research the assumption was that the relationship between projected hours and overhead expense was linear, meaning that if

hours, the independent variable, were plotted against expense, the dependent variable, a straight line could be used to approximate the relationship.

To accomplish the regression, the actual workload projections were multiplied by the actual workload norms to determine the actual estimated funded hours for each year. Assuming that the OVHD and G&A rates were set to recover the total amount of anticipated OVHD and G&A expense for that year, a regression was completed using the total OVHD and G&A expense versus the projected hours for each year to determine a basic predictor for both OVHD and G&A based on projected hours. Unfortunately, the model is only based on three data points, which admittedly is not the best technique for statistically accurate results. However in this case three data points were all the data that were available and the regression results produce reasonably accurate predictions when compared to the actual results. See Table 1 for a comparison of the model projections versus the actual projections. The actual regression models can be viewed in Figures 1 through 8. The large percentage error between the engine overhead model prediction and the actual prediction is a function of using only three data points and a relatively large, 12%, change in rates between fiscal years 2000 and 2001. The model could be made better by including many more data point for several years worth of data, but that was beyond the scope to this research.

Based on the simple regression results, the OVHD and G&A expenses that would have occurred were estimated for

		Model	Actual	% Error
1999	Aircraft OVHD	23,211,595	23,546,583	-1.42
	Aircraft G&A	10,039,101	10,173,539	-1.32
	Engine OVHD	4,822,261	4,443,843	8.52
	Engine G&A	1,100,224	1,062,641	3.54
2000	Aircraft OVHD	22,532,993	22,048,881	2.20
	Aircraft G&A	9,064,952	8,857,523	2.34
	Engine OVHD	6,900,327	6,919,143	-0.27
	Engine G&A	1,586,399	1,588,327	-0.12
2001	Aircraft OVHD	20,938,444	21,080,442	-0.67
	Aircraft G&A	6,775,941	6,831,795	-0.82
	Engine OVHD	4,711,284	5,070,068	-7.08
	Engine G&A	1,074,260	1,109,966	-3.22

Table 1. Model estimates vs. Actual projections

the new projected hours as a result of the change in input variables. To determine production overhead and G&A rates used for the sensitivity analysis the variable ‘norms’ was changed ten percent above and ten percent below the actual value. With each new value for the norms variable, the model was used to estimate what the overhead expense and G&A expense would have been given the change in norms. To determine what the approved rate would have been given the change in norms, the new estimated expense was divided by the new projected hours, again the assumption being that the rates are established to recover the total anticipated cost for the fiscal year. The actual labor rates were used without manipulation since higher authority provides labor acceleration rates and the NADEP knows the mix of employees on hand to determine labor rates. The billing result was recalculated based on the changed norms and the rates that would have been in effect with the changed norms using the actual execution volume and costs provided by the NADEP.

```
        -
Proj    -                                                        *
OVHD    -
Exp.    -
23000000+
        -
        -
        -
        -
22000000+                                        *
        -
        -
        -
        -
21000000+ *
        -
        -
          --------+---------+---------+---------+---------+--------Proj
             500000    550000    600000    650000    700000        Hours
```

Figure 1. Aircraft overhead vs. hours

Regression Analysis: Projected aircraft production overhead expense versus Projected hours

```
The regression equation is
Aircraft OVHD Expense = 17151704 + (8.22 * Projected hours)

Predictor        Coef     SE Coef          T        P
Constant     17151704     1895185       9.05    0.070
Projecte        8.216       3.016       2.72    0.224

S = 605580      R-Sq = 88.1%     R-Sq(adj) = 76.2%

Analysis of Variance

Source            DF          SS          MS         F        P
Regression         1 2.72089E+12 2.72089E+12      7.42    0.224
Residual Error     1 3.66727E+11 3.66727E+11
Total              2 3.08761E+12
```

Figure 2. Aircraft overhead expense model

```
 Proj    -
 G&A exp -                                                 *
         -
  9600000+
         -
         -
         -                                    *
         -
  8400000+
         -
         -
         -
         -
  7200000+
         -
         - *
         -
           --------+---------+---------+---------+---------+--------Proj
              500000    550000    600000    650000    700000        Hours
```

Figure 3. Aircraft G&A vs. hours

Regression Analysis: Projected aircraft G&A expense versus Projected hours

The regression equation is
Aircraft G&A expense = 1339988 + (11.8 * Projected hours)

Predictor	Coef	SE Coef	T	P
Constant	1339988	792453	1.69	0.340
Projecte	11.791	1.261	9.35	0.068

S = 253217 R-Sq = 98.9% R-Sq(adj) = 97.7%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	5.60346E+12	5.60346E+12	87.39	0.068
Residual Error	1	64118987620	64118987620		
Total	2	5.66757E+12			

Figure 4. Aircraft G&A expense model

```
         -
  7000000+                                                         *
         -
 OVHD    -
         -
         -
  6000000+
         -
         -
         -
         -
  5000000+   *
         -
         -
         -     *
         -
  4000000+
           --------+---------+---------+---------+---------+--------HOURS
               80000     88000     96000    104000    112000
```

Figure 5. Engine overhead vs. hours

Regression Analysis: Projected engine production overhead expense versus Projected hours

The regression equation is
Engine OVHD expense = 860457 + (51.4 * Projected hours)

Predictor	Coef	SE Coef	T	P
Constant	860457	1414172	0.61	0.652
HOURS	51.45	15.40	3.34	0.185

S = 521805   R-Sq = 91.8%   R-Sq(adj) = 83.6%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	3.04050E+12	3.04050E+12	11.17	0.185
Residual Error	1	2.72280E+11	2.72280E+11		
Total	2	3.31278E+12			

Unusual Observations

Obs	HOURS	OVHD	Fit	SE Fit	Residual	St Resid
2	117393	6919143	6899970	521453	19173	1.00 X

X denotes an observation whose X value gives it large influence.

Figure 6. Engine overhead expense model

```
        -
 1600000+                                                        *
        -
G&A     -
        -
        -
 1400000+
        -
        -
        -
        -
 1200000+
        -
        -   *
        -     *
        -
 1000000+
          --------+---------+---------+---------+---------+--------HOURS
              80000     88000     96000    104000    112000
```

Figure 7. Engine G&A vs. hours

Regression Analysis: Projected engine G&A expense versus Projected hours

```
The regression equation is
Engine G&A expense = 173339 + (12.0 * Projected hours)

Predictor        Coef     SE Coef          T        P
Constant       173339      140592       1.23    0.434
HOURS          12.037       1.531       7.86    0.081

S = 51876       R-Sq = 98.4%     R-Sq(adj) = 96.8%

Analysis of Variance

Source            DF          SS          MS         F        P
Regression         1 1.66447E+11 1.66447E+11     61.85    0.081
Residual Error     1  2691105144  2691105144
Total              2 1.69138E+11

Unusual Observations
Obs      HOURS        G&A         Fit      SE Fit    Residual    St Resid
  2     117393    1588327     1586421       51841        1906        1.00 X

X denotes an observation whose X value gives it large influence.
```

Figure 8. Engine G&A expense model

The same calculations were performed for a ten percent increase and decrease in workload projections. The last step was to plot the new projected values of NOR against each variable that changed to see which variable caused the steepest slope to occur. Table 2 shows a comparison of relative sensitivity of operating result to changes in input variables. Larger numbers in Table 2 equate to steeper slopes and therefore more sensitivity. The full set of plotted lines can be seen in Appendix C.

	Aircraft			Engines		
	Norms	WKLD	Rates	Norms	WKLD	Rates
1999	48.3	21.9	64.9	90.4	27.3	16.1
2000	49.9	19.7	45.1	92.3	12.3	16.3
2001	50.9	45.7	51.9	94.1	23.1	11.8

Table 2. Sensitivity analysis

Based on the sensitivity analysis, it appears that the aircraft work center operating result is strongly influenced by changes to workload norms and changes to approved rates while less influenced by differences between projected and allocated workload. The engine work center operating result appears to be most strongly affected by changes to workload norms and to a lesser extent by workload projections and changes to rates. The plots of changes to workload projections for 1999 and 2001 did not produce reliable slope indications. This was a function of using very few data points and a large percentage increase

in OVHD and G&A rates during that time period. The sensitivity analysis would most likely be improved by increasing the number of data points in the original regression model.

D. VARIANCE ANALYSIS

1. Definition

Any deviation from a planned result can be defined as a variance. A variance can result from myriad factors including differences between planned and actual activity level, changes from planned cost of inputs, changes from the planned efficiency of the workforce, or any number of other factors. A favorable variance is one that, taken alone, results in additional operating profit while an unfavorable variance is one that, taken alone, results in decreased operating profit [Ref 13 page 669]. The general model for cost variance analysis is the comparison of actual input quantities and prices with standard input quantities and prices at the *actual activity level*. The total variance can be further broken down into price variance and efficiency variance. Price variance is defined as the difference between actual costs and budgeted costs arising from changes in the cost of inputs to a production process. Efficiency variance is the difference between budgeted and actual results arising from changes in inputs that were budgeted per unit and the actual quantity of inputs used per unit. [Ref 13 page 705] The workload norms for each output at the NADEP are the standard number of hours that it should take workers to complete the job. The stabilized rate can be thought of as the standard price

per direct labor hour. Using these standard costs one can compute a price and efficiency variance for each output at the NADEP.

2. Process

This thesis looked specifically at the work for H-53 and H-46 aircraft, and T-64 and T-58 engines. As mentioned earlier the stabilized rate is composed of different segments including direct labor, production overhead, G&A expense, and a factor for surcharges, recoupments, and adjustments. An analysis was made for variance caused by labor, OVHD, and G&A only. The standard rates for these three inputs were determined by disaggregating the approved stabilized rates that were provided by NADEP Cherry Point in the form of billing rate sheets for each fiscal year.

The actual labor costs were compared to what the labor costs should have been at the actual activity level using the standard approved labor rates. This difference is the price variance as described above. The labor price variance can be thought of as a rate variance. It is the variation caused by the actual labor rate being different from the standard labor rate. In the case of the NADEP the standard labor rate is the approved direct labor portion of the stabilized rate. To determine the efficiency variance, the labor costs that should have occurred given the actual number of hours is compared to the labor costs that should have occurred for the actual level of activity using the standard hours. This variance gives you an idea of how closely your workforce met the standard hours. Favorable variance here would mean that the labor hours required for the actual output level were less than the standard

allowed. In some sense one could say that the employees were working more efficiently than the standard because they produced the output with fewer hours than the norms allowed. Efficiency variance however is not simply a measure of efficiency; one has to also consider the standards. A consistently favorable efficiency variance may signal that the standards are not accurate and should be decreased to be more in line with actual results. A comparison of the variances can be seen in Table 3.

Table 3 is broken out by fiscal year and then again by work center within each fiscal year. Rate variances are listed in the left column in the following order, Labor rate variance, production overhead rate variance, and G&A rate variance. Efficiency variances are listed in the right column, again in the order of labor, production overhead, and G&A. Negative numbers in the Table 3 equate to favorable variances and positive numbers equate to unfavorable variances. Some trends are immediately noticeable from the table. For example, during the three years studied there was only one favorable labor rate variance. This variance includes both government civilian labor and contracted labor in aggregate. Additionally, the proportional magnitude of the labor rate variance is similar for the aircraft work center and the engine work center. Another trend that can be noticed is that the efficiency variances are unfavorable most of the time. In fiscal years 2000 and 2001 each efficiency variance is unfavorable for every work center.

		Favorable	Unfavorable		Favorable	Unfavorable
1999 H-46	LRV		1,099,630	LEV		2,213,293
	ORV		1,131,732	OEV		2,499,737
	GRV	(832,789)		GEV		1,080,037
H-53	LRV		801,800	LEV	(161,650)	
	ORV		1,877,240	OEV	(182,571)	
	GRV	(690,820)		GEV	(78,881)	
T-64	LRV		299,561	LEV	(200,363)	
	ORV	(471,381)		OEV	(429,052)	
	GRV	(152,978)		GEV	(102,598)	
T-58	LRV		148,079	LEV		235,362
	ORV	(375,700)		OEV		503,998
	GRV	(98,172)		GEV		120,519
2000 H-46	LRV		1,019,558	LEV		2,127,455
	ORV		2,084,294	OEV		2,401,228
	GRV		278,169	GEV		964,626
H-53	LRV		401,194	LEV		1,044,605
	ORV		1,493,503	OEV		1,179,032
	GRV		67,694	GEV		473,643
T-64	LRV		625,800	LEV		271,201
	ORV		227,918	OEV		554,058
	GRV	(14,312)		GEV		127,187
T-58	LRV		423,095	LEV		176,341
	ORV	(100,769)		OEV		360,262
	GRV	(1,033,036)		GEV		82,700
2001 H-46	LRV	(162,449)		LEV		894,179
	ORV	(2,668,244)		OEV		1,325,483
	GRV		1,575,917	GEV		429,565
H-53	LRV		12,652	LEV		289,205
	ORV	(1,004,127)		OEV		428,701
	GRV		731,775	GEV		138,934
T-64	LRV		124,126	LEV		176,063
	ORV	(1,066,128)		OEV		389,501
	GRV		214,181	GEV		85,272
T-58	LRV		109,608	LEV		104,617
	ORV	(1,052,652)		OEV		231,444
	GRV		240,939	GEV		50,669

Table 3. Variance comparisons

A third trend that can be observed is that the magnitude of the efficiency variance, in both absolute and percentage terms, is much higher in the aircraft work center. A final trend that one can observe is that the oldest, H-46, airframe has the largest unfavorable efficiency variance.

E. SUMMARY

This analysis seems to support the need for increasing the workload norms at NADEP Cherry Point. The variance analysis indicated a strong tendency for the efficiency variance to be unfavorable. A consistently unfavorable efficiency variance may signify that the workload norms are set lower than the amount of work actually required. This may be due to the fact that the engineering models are not directly accounting for the increasing age of the aircraft and the scope of work required to bring the older helicopters up to specification is not being accounted for [Ref 14]. Another reason for an unfavorable efficiency variance might be caused by workload mix being significantly different from the projected mix. As discussed earlier, employees who are moved to areas other than their dominant skill set, will most likely require more time than the standard to complete work. The sensitivity analysis indicates that for both aircraft and engines, changes to the workload norms have a relatively large influence on the operating result. A closer look at workload norms may be called for in this case.

There are also some findings that are counter-intuitive. For example during the interviews with

employees from NADEP, workload allocations were often brought up as a possible explanation for operating results being less than desired. It does seem reasonable that if workload is projected higher than execution, then the rates would have been set too low to recover actual expenses and the result would be an operating loss. The sensitivity analysis however, seems to indicate that changes to workload projections have the smallest effect on the operating result relative to the other input variables. Some recommendations and conclusions will be discussed in the next section.

V. CONCLUSION AND RECOMMENDATIONS

A. SUMMARY

The business operations within the Navy Working Capital Fund, specifically NADEP Cherry Point, are extremely complicated. Rates, or prices, are set to recover the full cost of doing business including direct labor, production overhead, and general and administrative expenses. However not all overhead, for example that associated with maintaining war contingency capability, is included in the stabilized rate. Determining rates is a complex process that begins two years prior to the year the rates will actually be used and is tied to the PPBS process. In addition to cost recovery, affordability is also considered when determining rates as the PPBS process allocates scare resources to NWCF customers. Once they are set the rates cannot be easily changed during the year of execution. All of these factors make achieving the goal of zero NOR a difficult target to hit.

The primary goal of the research was to determine which of the input variables (workload norms, workload allocation, or rate setting) had the most influence on the bottom line at the NADEPs. This becomes important for managers as the complexity of the organization increases. Managers are less able to be involved in all the details of decision making because they simply do not have the time to stay current on every detailed aspect of the organization. As such, the decision maker has a limited amount of time and should concentrate his efforts on the situations that offer the highest return for his investment of time.

Knowing which variables have the most influence on the bottom line allows managers to focus more effectively on those issues that provide the best possible return for the investment of management time.

B. RESEARCH QUESTIONS

1. Primary

Which of the three main input variables (stabilized rates, workload standards, or workload allocation) has the most influence on the outcome of the net operating result? The sensitivity analysis seems to point to the fact that changes to workload norms have the largest impact on operating result for both the aircraft and engine work centers. That trend is evidenced for all three years included in the study as seen in Table 2. For the aircraft work center, the results of the sensitivity analysis for workload allocation seem to support the argument that NOR is less affected by workload allocation than other factors. However, for the engines work center, the results are not as concrete. The sensitivity plots for workload changes in both 1999 and 2001 do not provide statistically significant results. The models could be made better by including more data points for a longer period of time. This finding is counterintuitive based on the interviews, as it would seem more logical for workload allocation to have a large effect on the operating results for the reasons mentioned in the previous section. Since stabilized rates are a function of the workload norms and the projected volume of workload, the sensitivity of NOR to changes in rate were included for comparison purposes only. The rates cannot be changed unless there is a respective change in workload allocation or norms.

2. Secondary

How effective are the current models at achieving the desired results? One can see from the variance analysis that the swings from positive to negative are often very large. It would appear that the existing models do not make gradual changes to keep the NOR oscillating close to zero. The analysis seems to indicate that the norms are probably not set correctly. The consistent unfavorable efficiency variance either indicates that the employees are working inefficiently, or the norms are set too low. This is particularly noticeable for the aircraft, where the unfavorable efficiency variance resulted in costs exceeding expectations by an average of over 15%. This finding is also counterintuitive because of the overwhelming confidence expressed by interviewees about the norm setting process. It is surprising however, that the algorithm for setting norms does not specifically factor in age of the aircraft. The H-46, which is the oldest aircraft, accounts for the largest unfavorable efficiency variance in both absolute and percentage terms.

The strong trend in unfavorable labor rate variance might lead to the conclusion that standard labor rates are set too low. Even though higher authority provides the labor acceleration rate, the mix of wage earners should be known by the NADEP and a more accurate labor rate should be determined. The analysis also seems to suggest that the variance due to changes in rates appears extreme. For example, in 1999 and 2000 the aircraft work center had a collective $3 million and $3.5 million unfavorable overhead rate variance respectively, but in 2001 the same work

center experienced a favorable overhead rate variance of over $3.6 million. In order to determine if the long term trend is cyclical an analysis would have to be completed for a much longer period of time.

In general the existing models seem to provide rates that result in either feast or famine. However, the process as described above is not as simple as just determining a rate that accounts for zero NOR. The PPBS process and other political factors ultimately affect the approved rates. Since this research did not specifically model the interrelationships between the PPBS process, the political environment, and the existing models, it is difficult to determine in absolute terms how effective the existing models are.

Where should management focus its attention to get the most return on effort? As indicated by the sensitivity analysis, the variable that appears to be most influential to changes in the outcome of NOR is workload standard. Additionally, the variance analysis strongly suggests that the norms are currently not set properly. A suggestion for management would be to take a close look at the algorithm used to determine workload standards and focus attention on getting that piece of the puzzle correct. Specifically it may be worth looking at the long term trend in actual hours required for aircraft to determine if a factor could be determined to expressly account for the age of the aircraft.

Can existing data be used to develop a new forecasting model? The data that were provided could be used to develop a more robust regression model to predict costs.

The main limitation to the model used in this research was the limited number of data points. If enough years of data could be found to generate thirty or more data points, then a much better model would result. Modelers would definitely have to consider the effects of inflation when developing a model that covers such a large segment of time. Given the relationships between the PPBS process and the business operations at the NADEP however, development of a purely mathematical model may not necessarily provide "better" results. A total systems model that incorporated the more qualitative effects of organizational structure, internal and external policy decisions, public law, and distributing limited resources, would produce a much more insightful model. For example, regardless of how accurately the NADEP could predict rates and workload, the fact is that funding is limited and NADEP might not have access to the resources due to a change in priority or some other external mandate.

C. RECOMMENDATIONS FOR FURTHER RESEARCH

Business operations at all working capital fund activities are, and will continue to be, of great interest to the Congress due to the sheer size of the resources involved. Additionally, the current trend in out-sourcing commercial activities to the private sector will most likely continue. For NADEPs to remain a viable agency they must develop better methods of predicting operating results.

(1) Do other activities, NADEPs, shipyards, supply accounts, have similar drastic fluctuations in NOR?

Research could be completed similar to this research to determine if the results found here could be duplicated at other NWCF activities. That may shed some light on whether the problems are systemic or a function of some other factors.

(2) Develop a systems model to integrate the effects of the rate setting process with the PPBS and other external influences.

APPENDIX A. REPRESENTATIVE RAW DATA

This Appendix includes a representative look at the raw data that were used as the starting point. A snapshot of the information for aircraft, engines, workload and norms is included in the following pages. The information was provided by NADEP Cherry Point.

PROGRAM	DIRECT LABOR RATE	DIRECT MATERIAL RATE	PROD. EXPENSE RATE	G&A EXPENSE RATE	RECOUP.	SUR-CHARGE	ADJ.	TOTAL
AIRCRAFT	$28.28	**	$31.94	$13.80	$0.64	$1.62	$0.05	$76.33
AIRCRAFT - INTERSERVICE	$28.28	**	$31.94	$13.80	$0.64	$1.62	$0.00	$76.28
AIRCRAFT - FMS	$28.28	**	$31.94	$13.80	$0.00	$0.00	$0.00	$74.02
AIRCRAFT MODIFICATION	$28.02	$0.00	$32.40	$13.80	$0.64	$1.62	($0.06)	$76.42
AIRCRAFT MODIFICATION - INTERSERVICE	$28.02	$0.00	$32.40	$13.80	$0.64	$1.62	$0.00	$76.48
AIRCRAFT MODIFICATION - FMS	$28.02	$0.00	$32.40	$13.80	$0.00	$0.00	$0.00	$74.22
ISR/ASPA - EMERGENCY REPAIR	$27.35	$21.10	$26.98	$13.80	$0.64	$1.62	$0.05	$91.54
ENGINES	$26.95	**	$57.71	$13.80	$0.64	$1.62	$0.86	$101.58
ENGINES - INTERSERVICE	$26.95	**	$57.71	$13.80	$0.64	$1.62	$0.00	$100.72
ENGINES - FMS	$26.95	**	$57.71	$13.80	$0.00	$0.00	$0.00	$98.46
ENGINE FIELD TEAM ASSIST	$26.95	$30.21	$57.71	$13.80	$0.64	$1.62	$0.86	$131.79

TMS INFORMATION					STANDARDS			BUDGETED EXPENSE		ACTUAL EXPENSE						
TM	TMS	Ind FY	JON	BUNO	WKLD STD	TOT LABOR HRS	MATL STD	BUDGET COST (FIX PRICE)	PLAN TOT COST (LESS ADJ)	ACTUAL CIV COST	ACTUAL MATL COST	ACTUAL OTHER COST	PROD O/H	GA O/H	ACTUAL TOTAL COST	BILLING GAIN/(LOSS)
H46	CH46D	99	A2D3601	152567	8,439	12,092	209,222	853,371	833,877	337,304	198,089	9,758	427,850	150,092	1,123,094	(269,723)
H46	CH46D	99	A3A3601	150957	8,439	10,967	209,222	853,371	833,877	308,961	206,670	16,239	375,153	133,002	1,040,026	(186,655)
H46	CH46D	99	A4A3601	153352	8,439	11,789	209,222	853,371	833,877	343,810	208,876	21,698	408,477	143,645	1,126,507	(273,136)
H46	CH46D	99	A4A3602	153326	8,439	12,320	209,222	853,371	833,877	356,128	242,738	26,219	413,240	150,286	1,188,611	(335,240)
H46	CH46D	00	A6C3601	151957	10,634	14,226	177,902	933,857	997,252	363,629	241,686	63,296	506,954	132,661	1,308,226	(374,369)
H46	CH46D	00	A7A3601	153345	10,634	13,270	177,902	933,857	997,252	358,288	210,656	50,105	462,358	113,049	1,194,457	(260,600)
H46	CH46D	00	A8D3601	153338	9,856	14,387	177,902	933,857	937,307	418,892	280,071	47,138	628,800	236,278	1,611,178	(677,321)
H46	CH46E	99	09E3611	156477	8,633	11,072	187,210	835,548	815,606	333,141	203,449	7,020	388,654	141,636	1,073,900	(238,352)
H46	CH46E	99	A2B3605	157662	8,954	9,405	189,857	873,316	852,632	206,399	169,271	90,789	325,529	119,057	911,044	(37,728)
H46	CH46E	99	A2B3602	157650	8,954	9,898	189,857	873,316	852,632	287,117	173,640	5,272	346,951	125,199	938,178	(64,862)
H46	CH46E	99	A2B3601	152579	8,954	9,574	189,857	873,316	852,632	269,470	181,067	6,739	341,531	120,520	919,326	(46,010)
H46	CH46E	99	A2B3606	154798	8,954	8,633	189,857	873,316	852,632	244,732	151,089	3,344	299,227	108,265	806,656	66,660
H46	CH46E	99	A2C3601	155302	8,954	8,437	189,857	873,316	852,632	207,064	163,711	44,140	301,431	104,291	820,637	52,679
H46	CH46E	99	A3E3601	157664	8,954	10,796	189,857	873,316	852,632	302,872	187,626	16,856	381,324	133,036	1,021,715	(148,399)
H46	CH46E	99	A3E3602	153353	8,954	9,596	189,857	873,316	852,632	228,298	193,839	64,370	332,622	117,565	936,694	(63,378)
H46	CH46E	99	A3E3603	157692	8,954	9,399	189,857	873,316	852,632	258,112	185,235	17,877	325,629	114,704	901,557	(28,241)
H46	CH46E	99	A3E3605	154834	8,954	11,071	189,857	873,316	852,632	315,982	191,393	9,292	386,453	134,822	1,037,942	(164,626)
H46	CH46E	99	A3E3606	156471	8,954	10,166	189,857	873,316	852,632	280,819	187,271	18,137	344,135	123,009	953,372	(80,056)
H46	CH46E	99	A3F3601	155312	8,954	8,616	189,857	873,316	852,632	205,757	181,802	54,445	289,689	104,168	835,861	37,455
H46	CH46E	99	A3E3604	153973	8,954	8,678	189,857	873,316	852,632	243,142	187,096	15,895	301,371	105,128	852,632	20,684
H46	CH46E	99	A4C3601	153975	8,954	9,961	189,857	873,316	852,632	207,615	186,309	109,938	332,980	119,569	956,411	(83,095)
H46	CH46E	99	A4C3605	153969	8,954	11,794	189,857	873,316	852,632	242,526	201,101	135,067	396,249	143,182	1,118,126	(244,810)
H46	CH46E	99	A4C3602	155307	8,954	12,230	189,857	873,316	852,632	268,440	213,969	119,924	406,608	148,220	1,157,161	(283,845)
H46	CH46E	99	A4C3607	155303	8,954	9,972	189,857	873,316	852,632	281,293	220,796	30,043	330,754	121,967	984,853	(111,537)
H46	CH46E	99	A4C3606	157703	8,954	11,497	189,857	873,316	852,632	336,011	219,236	23,664	378,109	140,114	1,097,134	(223,818)
H46	CH46E	99	A4C3603	153368	8,954	12,960	189,857	873,316	852,632	284,377	257,026	148,838	428,898	158,773	1,277,911	(404,595)
H46	CH46E	99	A4D3601	153962	9,684	9,940	191,302	930,482	908,112	264,194	208,835	56,840	323,337	121,400	974,606	(44,124)
H46	CH46E	99	A5C3601	157660	10,184	14,681	191,302	968,647	945,122	400,957	201,262	58,919	485,381	180,653	1,327,173	(358,526)
H46	CH46E	99	A5C3605	156422	10,184	16,140	191,302	968,647	945,122	452,119	234,154	56,806	553,879	191,942	1,488,900	(520,253)
H46	CH46E	99	A5C3606	156429	10,184	12,771	191,302	968,647	945,122	253,303	226,026	154,254	426,051	151,646	1,211,280	(242,633)
H46	CH46E	99	A5C3603	153999	10,184	11,513	191,302	968,647	945,122	239,064	264,562	126,964	400,503	131,551	1,162,644	(193,997)
H46	CH46E	99	A5C3607	156434	10,184	11,636	191,302	968,647	945,122	237,379	219,122	135,668	401,145	132,949	1,126,263	(157,616)
H46	CH46E	99	A5D3601	154860	10,184	12,167	191,302	930,482	945,122	322,683	194,443	55,762	429,272	138,018	1,140,179	(209,697)
H46	CH46E	99	A5C3609	156439	10,184	12,382	191,302	968,647	945,122	254,379	199,817	140,039	439,610	138,838	1,172,684	(204,037)
H46	CH46E	99	A5C3608	154827	10,184	15,149	191,302	968,647	945,122	398,714	206,862	70,726	542,921	166,073	1,385,297	(416,650)
H46	CH46E	99	A5C3602	157680	10,184	11,001	191,302	968,647	945,122	269,142	200,823	81,880	414,753	122,008	1,088,605	(119,958)
H46	CH46E	99	A5C3611	154040	10,184	12,183	191,302	968,647	945,122	302,810	187,557	70,387	446,701	125,052	1,132,507	(163,860)
H46	CH46E	99	A5C3604	156470	10,184	11,651	191,302	968,647	945,122	234,034	200,030	142,705	421,866	116,199	1,114,835	(146,188)
H46	CH46E	99	A5C3610	157654	10,184	12,651	191,302	968,647	945,122	222,289	195,246	185,655	457,361	120,359	1,180,910	(212,263)
H46	CH46E	00	A6A3604	155315	10,725	12,543	199,060	980,173	1,025,421	308,015	239,451	72,039	442,810	110,995	1,173,310	(193,137)
H46	CH46E	00	A7B3602	157665	10,725	12,935	199,060	980,173	1,025,421	333,745	205,675	52,075	460,690	113,567	1,165,752	(185,579)
H46	CH46E	00	A6D2301	157670	15,139	15,139	0	1,457,996	1,463,294	274,773	296,840	214,261	552,634	144,136	1,482,643	(24,648)
H46	CH46E	00	A5K2301	156445	14,006	14,006	0	1,338,758	1,343,660	237,697	269,716	212,304	485,674	125,308	1,330,699	8,060
H46	CH46E	00	A7B3601	157726	10,725	12,394	199,060	980,173	1,025,421	310,379	209,687	66,110	437,726	107,028	1,130,930	(150,757)
H46	CH46E	00	A7B3603	153350	10,725	13,951	199,060	1,021,668	1,025,422	253,094	245,670	199,970	519,032	126,121	1,343,886	(322,218)
H46	CH46E	00	A7B3606	157651	10,725	14,153	199,060	1,021,668	1,025,422	384,421	247,544	61,386	535,607	130,256	1,359,213	(337,545)
H46	CH46E	00	A8A3605	156452	10,184	12,135	199,060	980,173	983,737	252,023	268,900	150,282	476,193	146,268	1,293,666	(313,493)

		STANDARDS			INDUCTIONS			
TMS	SUBMISSION	HOURS	MAT'L	CARRY-IN	1ST QTR	2ND QTR	3RD QTR	4TH QTR
CH46D	BREAKEVEN	0	$ -	0	0	0	0	0
	NWCF	0	$ -	0	0	0	0	0
	EXECUTION	0	$ -	1	0	0	0	0
CH46E	BREAKEVEN	10184	$188,900	14	5	8	8	7
	NWCF	11412	$215,920	17	6	7	7	6
	EXECUTION	11412	$215,920	10	3	5	0	0
(LES)nosepull	EXECUTION	11712	$256,993	0	0	0	6	7
FY02 STD	EXECUTION	12885	$289,749	0	0	0	0	3
HH46D	BREAKEVEN	11292	$149,639	3	0	1	0	1
	NWCF	11405	$214,894	4	1	1	0	0
All Carry Out from I	EXECUTION	11405	$214,894	6	0	1	0	0
UH46D	BREAKEVEN	0	$ -	0	0	0	0	0
	NWCF	0	$ -	0	0	0	0	0
	EXECUTION	0	$ -	0	0	0	0	0
H-46 TOTAL	BREAKEVEN	N/A	N/A	17	5	9	8	8
	NWCF	N/A	N/A	21	7	8	7	6
	EXECUTION	N/A	N/A	17	3	6	0	0
CH53D	BREAKEVEN	12500	$519,750	1	0	0	0	1
	NWCF	12500	$521,959	1	0	0	1	0
	EXECUTION	0	$ -	0	0	0	0	0
CH53E	BREAKEVEN	11025	$395,656	21	4	5	5	4
	NWCF	11025	$395,656	17	2	5	4	4
	EXECUTION	11025	$395,656	14	3	4	3	3
FY02 STD	EXECUTION	12261	$416,748	0	0	0	0	2
MH53E	BREAKEVEN	10554	$400,453	2	1	2	1	1
	NWCF	10554	$327,359	2	1	2	2	1
	EXECUTION	10554	$327,359	3	0	1	2	2
H-53 TOTAL	BREAKEVEN	N/A	N/A	24	5	7	6	6
	NWCF	N/A	N/A	20	3	7	7	5
	EXECUTION	N/A	N/A	17	3	5	5	7

				BUDGETED EXPENSE		ACTUAL EXPENSE						
TMS	**Ind FY**	**WKLD STD**	LABOR	MATL STD	BUDGET COST (FIX PRICE)	PLAN TOT COST (LESS ADJ)	ACTUAL CIV COST	ACTUAL MATL COST	ACTUAL OTHER COST	PROD O/H	GA O/H	AL TOTAL	**BILLING GAIN/(LOSS)**
T64GE100 AF	99	965	1,042	169,741	266,936	264,755	28,653	132,808	0	58,149	13,101	232,711	34,225
T64GE100 AF	99	504	395	74,572	125,335	124,196	11,256	16,295	0	22,017	4,899	54,467	70,868
T64GE100 AF	99	965	1,169	169,741	266,936	264,755	33,576	222,149	494	64,879	14,356	335,453	(68,517)
T64GE100 AF	99	965	718	169,741	266,936	264,755	19,744	125,702	209	39,806	8,819	194,279	72,657
T64GE100 AF	99	504	1,112	74,572	125,335	124,196	32,759	147,073	456	62,490	13,604	256,383	(131,048)
T64GE100 AF	99	965	1,267	169,741	266,936	264,755	31,245	182,127	5,289	61,572	15,246	295,479	(28,543)
T64GE100 AF	99	965	1,023	169,741	266,936	264,755	27,053	134,558	3,055	49,085	12,331	226,083	40,853
T64GE100 AF	99	965	690	169,741	266,936	264,755	16,899	95,978	3,777	33,408	8,304	158,366	108,570
T64GE100 AF	99	965	891	169,741	266,936	264,755	22,640	202,093	4,204	42,176	10,730	281,843	(14,907)
T64GE100 AF	99	965	1,018	169,741	266,936	264,755	24,547	180,387	6,920	48,543	12,259	272,656	(5,720)
T64GE100 AF	99	965	886	169,741	266,936	264,755	21,358	137,378	6,138	40,123	10,801	215,798	51,138
T64GE100 AF	99	965	1,032	169,741	266,936	264,755	26,809	144,772	6,421	51,339	12,735	242,076	24,860
T64GE100 AF	99	965	1,015	169,741	266,936	264,755	23,367	200,306	8,870	49,328	12,457	294,329	(27,393)
T64GE100 AF	99	965	687	169,741	266,936	264,755	17,539	176,646	4,139	34,630	8,504	241,457	25,479
T64GE100 AF	99	965	867	169,741	266,936	264,755	20,198	211,625	6,931	41,608	10,550	290,912	(23,976)
T64GE100 AF	99	965	1,016	169,741	266,936	264,755	23,916	271,685	8,439	50,035	12,518	366,593	(99,657)
T64GE100 AF	99	965	1,089	169,741	266,936	264,755	26,513	281,950	8,367	54,579	13,415	384,824	(117,888)
T64GE100 AF	99	965	920	169,741	266,936	264,755	21,828	276,329	7,013	46,275	11,290	362,735	(95,799)
T64GE100 AF	99	965	1,005	169,741	266,936	264,755	25,890	195,861	6,250	51,974	12,234	292,209	(25,273)
T64GE100 AF	99	504	420	74,572	125,335	124,196	10,503	22,002	4,180	22,280	5,283	64,247	61,088
T64GE100 AF	99	965	782	169,741	266,936	264,755	16,251	176,219	8,512	39,853	8,632	249,468	17,468
T64GE100 AF	99	965	1,008	169,741	266,936	264,755	25,159	273,981	7,256	51,749	11,017	369,161	(102,225)
T64GE100 AF	99	965	1,098	169,741	266,936	264,755	23,580	182,426	10,902	57,831	11,945	286,684	(19,748)
T64GE100 AF	99	965	914	169,741	266,936	264,755	20,981	132,583	8,808	47,342	9,839	219,554	47,382
T64GE413	99	932	1,319	209,164	303,837	300,929	38,160	160,081	0	78,164	16,753	293,158	10,679
T64GE413	99	749	551	122,797	198,881	196,544	15,530	66,829	0	31,858	6,862	121,078	77,803
T64GE413	99	749	763	122,797	198,880	196,543	22,909	87,156	702	43,244	9,384	163,395	35,485
T64GE413	99	932	1,017	209,164	303,837	300,929	28,925	157,475	394	57,327	12,491	256,612	47,225
T64GE413	99	749	503	122,797	198,881	196,544	14,223	24,014	1,295	27,771	6,167	73,470	125,411
T64GE413	99	932	878	209,164	303,837	300,929	21,885	337,375	5,232	41,536	10,772	416,801	(112,964)
T64GE413	99	932	609	209,164	303,837	300,929	13,716	81,036	8,240	30,938	8,075	142,005	161,832
T64GE413	99	932	893	209,164	303,837	300,929	20,478	294,634	7,880	46,577	11,051	380,620	(76,783)

		STANDARDS		INDUCTIONS				
TMS	SUBMISSION	MANHOURS	MATERIAL	1ST QTR	2ND QTR	3RD QTR	4TH QTR	**TOTAL**
T58GE400B OVHL	BREAKEVEN	604	$ 19,609	2	3	3	2	**10**
	NWCF	923	$ 19,609	2	3	3	2	**10**
	EXECUTION	933	$ 21,504	1	2	2	3	**8**
T58GE16 MREP	BREAKEVEN	433	$ 69,303	2	2	2	1	**7**
	NWCF	459	$ 69,303	2	3	3	2	**10**
	EXECUTION	463	$ 90,332	6	13	9	8	**36**
T58GE16 REP	BREAKEVEN	365	$ 45,835	12	13	13	12	**50**
	NWCF	362	$ 45,835	8	10	10	9	**37**
	EXECUTION	366	$ 57,232	5	7	12	17	**41**
T58GE402 MREP	BREAKEVEN	425	$ 47,366	1	0	1	0	**2**
	NWCF	474	$ 47,366	1	1	1	1	**4**
	EXECUTION	484	$ 65,982	5	8	6	10	**29**
T58GE402 MR SRPR	BREAKEVEN	N/A	N/A	0	0	0	0	**0**
	NWCF	N/A	N/A	0	0	0	0	**0**
	EXECUTION	508	$ 68,482	0	0	0	11	**11**
T58GE402 REP	BREAKEVEN	332	$ 35,874	12	12	12	11	**47**
	NWCF	332	$ 35,874	9	9	8	9	**35**
	EXECUTION	342	$ 44,401	3	7	8	6	**24**
T58GE402 REP SRPR	BREAKEVEN	N/A	N/A	0	0	0	0	**0**
	NWCF	N/A	N/A	0	0	0	0	**0**
	EXECUTION	366	$ 46,901	0	0	0	6	**6**
T58 TOTAL	**BREAKEVEN**	**N/A**	**N/A**	**29**	**30**	**31**	**26**	**116**
	NWCF	**N/A**	**N/A**	**22**	**26**	**25**	**23**	**96**
	EXECUTION	**N/A**	**N/A**	**20**	**37**	**37**	**61**	**155**

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APPENDIX B. REPRESENTATIVE WORKING DATA

This Appendix includes a snapshot of the data after they were manipulated to take out the variables that were not affected by changes to workload norms, workload projections, or stabilized rates. The author, using the data provided by NADEP Cherry Point, generated the data in this Appendix.

TMS	Ind FY	Approved workload standard	Actual labor hours	Fixed cost less material	Fixed cost less matl and other	Approved Stabilized rate	approved rate less other	ACTUAL CIV COST	Approved labor rate	Actual labor rate	PROD O/H	Approved OVHD rate	Actual OVHD rate	GA O/H	Approved G&A rate	Actual G&A rate	Actual cost less material	Billing Gain/(Loss) less material
CH46D	1999	8,439	12,092	644,149	624,655	76.33	74.02	347,062	28.28	28.70	427,850	31.94	35.38	150,092	13.80	12.41	925,005	(300,350)
CH46D	1999	8,439	10,967	644,149	624,655	76.33	74.02	325,201	28.28	29.65	375,153	31.94	34.21	133,002	13.80	12.13	833,356	(208,701)
CH46D	1999	8,439	11,789	644,149	624,655	76.33	74.02	365,508	28.28	31.00	408,477	31.94	34.65	143,645	13.80	12.18	917,631	(292,976)
CH46D	1999	8,439	12,320	644,149	624,655	76.33	74.02	382,347	28.28	31.03	413,240	31.94	33.54	150,286	13.80	12.20	945,873	(321,218)
CH46E	1999	8,954	9,405	683,459	662,775	76.33	74.02	297,188	28.28	31.60	325,529	31.94	34.61	119,057	13.80	12.66	741,773	(78,998)
CH46E	1999	8,954	9,898	683,459	662,775	76.33	74.02	292,389	28.28	29.54	346,951	31.94	35.05	125,199	13.80	12.65	764,538	(101,763)
CH46E	1999	8,954	9,574	683,459	662,775	76.33	74.02	276,209	28.28	28.85	341,531	31.94	35.67	120,520	13.80	12.59	738,260	(75,484)
CH46E	1999	8,954	8,633	683,459	662,775	76.33	74.02	248,076	28.28	28.74	299,227	31.94	34.66	108,265	13.80	12.54	655,568	7,208
CH46E	1999	8,954	8,437	683,459	662,775	76.33	74.02	251,204	28.28	29.78	301,431	31.94	35.73	104,291	13.80	12.36	656,926	5,849
CH46E	1999	8,954	10,796	683,459	662,775	76.33	74.02	319,729	28.28	29.61	381,324	31.94	35.32	133,036	13.80	12.32	834,088	(171,313)
CH46E	1999	8,954	9,596	683,459	662,775	76.33	74.02	292,668	28.28	30.50	332,622	31.94	34.66	117,565	13.80	12.25	742,855	(80,080)
CH46E	1999	8,954	9,399	683,459	662,775	76.33	74.02	275,989	28.28	29.36	325,629	31.94	34.65	114,704	13.80	12.20	716,322	(53,547)
CH46E	1999	8,954	11,071	683,459	662,775	76.33	74.02	325,274	28.28	29.38	386,453	31.94	34.91	134,822	13.80	12.18	846,549	(183,774)
CH46E	1999	8,954	10,166	683,459	662,775	76.33	74.02	298,957	28.28	29.41	344,135	31.94	33.85	123,009	13.80	12.10	766,101	(103,325)
CH46E	1999	8,954	8,616	683,459	662,775	76.33	74.02	260,202	28.28	30.20	289,689	31.94	33.62	104,168	13.80	12.09	654,059	8,716
CH46E	1999	8,954	8,678	683,459	662,775	76.33	74.02	259,037	28.28	29.85	301,371	31.94	34.73	105,128	13.80	12.11	665,536	(2,761)
CH46E	1999	8,954	9,961	683,459	662,775	76.33	74.02	317,553	28.28	31.88	332,980	31.94	33.43	119,569	13.80	12.00	770,102	(107,327)
CH46E	1999	8,954	11,794	683,459	662,775	76.33	74.02	377,593	28.28	32.02	396,249	31.94	33.60	143,182	13.80	12.14	917,025	(254,249)
CH46E	1999	8,954	12,230	683,459	662,775	76.33	74.02	388,364	28.28	31.76	406,608	31.94	33.25	148,220	13.80	12.12	943,192	(280,416)
CH46E	1999	8,954	9,972	683,459	662,775	76.33	74.02	311,336	28.28	31.22	330,754	31.94	33.17	121,967	13.80	12.23	764,057	(101,282)
CH46E	1999	8,954	11,497	683,459	662,775	76.33	74.02	359,675	28.28	31.28	378,109	31.94	32.89	140,114	13.80	12.19	877,898	(215,122)
CH46E	1999	8,954	12,960	683,459	662,775	76.33	74.02	433,215	28.28	33.43	428,898	31.94	33.10	158,773	13.80	12.25	1,020,886	(358,110)
CH46E	1999	9,684	9,940	739,180	716,810	76.33	74.02	321,034	28.28	32.30	323,337	31.94	32.53	121,400	13.80	12.21	765,771	(48,961)
CH46E	1999	10,184	14,681	777,345	753,820	76.33	74.02	459,877	28.28	31.33	485,381	31.94	33.06	180,653	13.80	12.31	1,125,911	(372,091)
CH46E	1999	10,184	16,140	777,345	753,820	76.33	74.02	508,925	28.28	31.53	553,879	31.94	34.32	191,942	13.80	11.89	1,254,746	(500,926)
CH46E	1999	10,184	12,771	777,345	753,820	76.33	74.02	407,557	28.28	31.91	426,051	31.94	33.36	151,646	13.80	11.87	985,254	(231,434)
CH46E	1999	10,184	11,513	777,345	753,820	76.33	74.02	366,029	28.28	31.79	400,503	31.94	34.79	131,551	13.80	11.43	898,082	(144,262)
CH46E	1999	10,184	11,636	777,345	753,820	76.33	74.02	373,046	28.28	32.06	401,145	31.94	34.47	132,949	13.80	11.43	907,141	(153,321)
CH46E	1999	10,184	12,382	777,345	753,820	76.33	74.02	378,445	28.28	30.56	439,610	31.94	35.50	138,838	13.80	11.21	956,894	(203,074)
CH46E	1999	10,184	15,149	777,345	753,820	76.33	74.02	469,440	28.28	30.99	542,921	31.94	35.84	166,073	13.80	10.96	1,178,435	(424,615)
CH46E	1999	10,184	11,001	777,345	753,820	76.33	74.02	351,021	28.28	31.91	414,753	31.94	37.70	122,008	13.80	11.09	887,783	(133,963)
CH46E	1999	10,184	12,183	777,345	753,820	76.33	74.02	373,196	28.28	30.63	446,701	31.94	36.67	125,052	13.80	10.26	944,950	(191,130)

Approved workload standard	plus 10%	minus 10%	Actual labor hours	Fixed cost less material	Fixed cost less matl and other	fixed cost with 10% more norm	fixed cost w/10% less norm	fixed cost w/10% more project	fixed cost w/10% less project	FC w/+10 rate	FC w/-10 rate	Approved Stabilized rate	approved rate less other	ACTUAL CIV COST	PROD O/H	GA O/H
8,439	9,283	7,595	12092	644,149	624,655	660,014	578,519	599,507	636,976	687,120	562,189	76.33	74.02	337304	427,850	150,092
8,439	9,283	7,595	10967	644,149	624,655	660,014	578,519	599,507	636,976	687,120	562,189	76.33	74.02	308961	375,153	133,002
8,439	9,283	7,595	11789	644,149	624,655	660,014	578,519	599,507	636,976	687,120	562,189	76.33	74.02	343810	408,477	143,645
8,439	9,283	7,595	12320	644,149	624,655	660,014	578,519	599,507	636,976	687,120	562,189	76.33	74.02	356128	413,240	150,286
8,954	9,849	8,059	9405	683,459	662,775	700,292	613,824	636,092	675,848	729,053	596,498	76.33	74.02	206399	325,529	119,057
8,954	9,849	8,059	9898	683,459	662,775	700,292	613,824	636,092	675,848	729,053	596,498	76.33	74.02	287117	346,951	125,199
8,954	9,849	8,059	9574	683,459	662,775	700,292	613,824	636,092	675,848	729,053	596,498	76.33	74.02	269470	341,531	120,520
8,954	9,849	8,059	8633	683,459	662,775	700,292	613,824	636,092	675,848	729,053	596,498	76.33	74.02	244732	299,227	108,265
8,954	9,849	8,059	8437	683,459	662,775	700,292	613,824	636,092	675,848	729,053	596,498	76.33	74.02	207064	301,431	104,291
8,954	9,849	8,059	10796	683,459	662,775	700,292	613,824	636,092	675,848	729,053	596,498	76.33	74.02	302872	381,324	133,036
8,954	9,849	8,059	9596	683,459	662,775	700,292	613,824	636,092	675,848	729,053	596,498	76.33	74.02	228298	332,622	117,565
8,954	9,849	8,059	9399	683,459	662,775	700,292	613,824	636,092	675,848	729,053	596,498	76.33	74.02	258112	325,629	114,704
8,954	9,849	8,059	11071	683,459	662,775	700,292	613,824	636,092	675,848	729,053	596,498	76.33	74.02	315982	386,453	134,822
8,954	9,849	8,059	10166	683,459	662,775	700,292	613,824	636,092	675,848	729,053	596,498	76.33	74.02	280819	344,135	123,009
8,954	9,849	8,059	8616	683,459	662,775	700,292	613,824	636,092	675,848	729,053	596,498	76.33	74.02	205757	289,689	104,168
8,954	9,849	8,059	8678	683,459	662,775	700,292	613,824	636,092	675,848	729,053	596,498	76.33	74.02	243142	301,371	105,128
8,954	9,849	8,059	9961	683,459	662,775	700,292	613,824	636,092	675,848	729,053	596,498	76.33	74.02	207615	332,980	119,569
8,954	9,849	8,059	11794	683,459	662,775	700,292	613,824	636,092	675,848	729,053	596,498	76.33	74.02	242526	396,249	143,182
8,954	9,849	8,059	12230	683,459	662,775	700,292	613,824	636,092	675,848	729,053	596,498	76.33	74.02	268440	406,608	148,220
8,954	9,849	8,059	9972	683,459	662,775	700,292	613,824	636,092	675,848	729,053	596,498	76.33	74.02	281293	330,754	121,967
8,954	9,849	8,059	11497	683,459	662,775	700,292	613,824	636,092	675,848	729,053	596,498	76.33	74.02	336011	378,109	140,114
8,954	9,849	8,059	12960	683,459	662,775	700,292	613,824	636,092	675,848	729,053	596,498	76.33	74.02	284377	428,898	158,773
9,684	10,652	8,716	9940	739,180	716,810	757,386	663,867	687,951	730,948	788,491	645,129	76.33	74.02	264194	323,337	121,400
10,184	11,202	9,166	14681	777,345	753,820	796,491	698,144	723,471	768,688	829,202	678,438	76.33	74.02	400957	485,381	180,653
10,184	11,202	9,166	16140	777,345	753,820	796,491	698,144	723,471	768,688	829,202	678,438	76.33	74.02	452119	553,879	191,942
10,184	11,202	9,166	12771	777,345	753,820	796,491	698,144	723,471	768,688	829,202	678,438	76.33	74.02	253303	426,051	151,646
10,184	11,202	9,166	11513	777,345	753,820	796,491	698,144	723,471	768,688	829,202	678,438	76.33	74.02	239064	400,503	131,551
10,184	11,202	9,166	11636	777,345	753,820	796,491	698,144	723,471	768,688	829,202	678,438	76.33	74.02	237379	401,145	132,949
10,184	11,202	9,166	12382	777,345	753,820	796,491	698,144	723,471	768,688	829,202	678,438	76.33	74.02	254379	439,610	138,838
10,184	11,202	9,166	15149	777,345	753,820	796,491	698,144	723,471	768,688	829,202	678,438	76.33	74.02	398714	542,921	166,073
10,184	11,202	9,166	11001	777,345	753,820	796,491	698,144	723,471	768,688	829,202	678,438	76.33	74.02	269142	414,753	122,008
10,184	11,202	9,166	12183	777,345	753,820	796,491	698,144	723,471	768,688	829,202	678,438	76.33	74.02	302810	446,701	125,052
10,184	11,202	9,166	11651	777,345	753,820	796,491	698,144	723,471	768,688	829,202	678,438	76.33	74.02	234034	421,866	116,199

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APPENDIX C. SENSITIVITY PLOTS

This Appendix contains the printout of the sensitivity plots for the variables that were changed. For each graph, the three plotted points correspond to the actual value, the actual value plus ten percent, and the actual value minus ten percent. The net operating result, dependent variable, is represented on each graph along the y-axis. The changing, independent, variable is represented along the x-axis. Each graph was generated using Minitab software and the regression analysis was done simply to provide the slope of each best fitting line. There are separate graphs for the variables workload norms, workload projections, and stabilized rates for each year and for both aircraft and engine work centers. Each graph and the corresponding regression are included on separate pages for the readers' convenience.

Plot: NOR versus Aircraft Norms in 1999

```
 NOR     -
         -
         -                                                       *
 -2500000+
         -
         -
         -
         -                             *
 -5000000+
         -
         -
         -
         -
 -7500000+
         -     *
         -
         -
           +---------+---------+---------+---------+---------+------A/C
      575000    600000    625000    650000    675000    700000      Norms
```

Slope = 48.3

Regression Analysis: NOR versus Aircraft Norms in 1999

```
The regression equation is
nor 99 = -36211847 + 48.3 norms 99

Predictor         Coef     SE Coef          T        P
Constant     -36211847     2399948     -15.09    0.042
norms 99        48.285       3.687      13.10    0.049

S = 338277      R-Sq = 99.4%     R-Sq(adj) = 98.8%

Analysis of Variance

Source            DF          SS          MS         F        P
Regression         1 1.96300E+13 1.96300E+13    171.54    0.049
Residual Error     1 1.14431E+11 1.14431E+11
Total              2 1.97444E+13
```

Plot: NOR versus Aircraft workload projections in 1999

```
        -   *
        -
-4000000+
        -
nor 99a -
        -                          *
        -
-5000000+
        -
        -
        -
        -
-6000000+
        -
        -
        -                                                        *
        -
          +---------+---------+---------+---------+---------+------wrkld 99
     675000    700000    725000    750000    775000    800000
```

Slope = 21.9

Regression Analysis: NOR versus Aircraft workload projections in 1999

```
The regression equation is
nor 99a =11359327 - 21.9 wrkld 99

Predictor        Coef     SE Coef          T        P
Constant     11359327     1851897       6.13    0.103
wrkld 99      -21.915       2.484      -8.82    0.072

S = 233865      R-Sq = 98.7%     R-Sq(adj) = 97.5%

Analysis of Variance

Source            DF          SS          MS         F        P
Regression         1 4.25699E+12 4.25699E+12     77.83    0.072
Residual Error     1 54692852878 54692852878
Total              2 4.31168E+12
```

Plot: NOR versus Aircraft stabilized rate in 1999

```
           -
         0+                                                     *
           -
 nor 99b -
           -
           -
 -3500000+
           -
           -                             *
           -
           -
 -7000000+
           -
           -
           -    *
           -
 -1.1E+07+
            --+---------+---------+---------+---------+---------+----rate 99
           66.0      69.0      72.0      75.0      78.0      81.0
```

```
Slope = 64.9
```

Regression Analysis: NOR versus Aircraft stabilized rate in 1999

```
The regression equation is
nor 99b = -52646215 + 649009 rate 99

Predictor        Coef     SE Coef          T        P
Constant    -52646215         130 -403818.15    0.000
rate 99        649009           2  369709.21    0.000

S = 18.37       R-Sq = 100.0%    R-Sq(adj) = 100.0%

Analysis of Variance

Source            DF          SS          MS         F        P
Regression         1 4.61312E+13 4.61312E+13 1.367E+11    0.000
Residual Error     1         338         338
Total              2 4.61312E+13
```

Plot: NOR versus Aircraft norms in 2000

```
 nor 00  -                                                      *
         -
         -
 -7500000+
         -
         -
         -
         -
 -9000000+
         -                                *
         -
         -
         -
 -1.1E+07+
         -
         -         *
         -
           ----+---------+---------+---------+---------+---------+--norms 00
          400000    420000    440000    460000    480000    500000
```

```
Slope = 49.9
```

Regression Analysis: NOR versus Aircraft norms in 2000

```
The regression equation is
nor 00 = -31598498 + 49.9 norms 00

Predictor        Coef     SE Coef          T        P
Constant    -31598498     2756574     -11.46    0.055
norms 00       49.890       6.091       8.19    0.077

S = 388546      R-Sq = 98.5%     R-Sq(adj) = 97.1%

Analysis of Variance

Source            DF          SS          MS         F        P
Regression         1 1.01284E+13 1.01284E+13     67.09    0.077
Residual Error     1 1.50968E+11 1.50968E+11
Total              2 1.02794E+13
```

Plot: NOR versus Aircraft workload projections in 2000

```
         -
 nor 00a -      *
         -
         -
 -8000000+
         -
         -
         -
         -
 -9000000+
         -
         -                             *
         -
         -
 -1.0E+07+
         -                                                     *
         -
           +---------+---------+---------+---------+---------+------wrkld 00
      570000    600000    630000    660000    690000    720000
```

Slope = 19.7

Regression Analysis: NOR versus Aircraft workload projections in 2000

```
The regression equation is
nor 00a = 3892261 - 19.7 wrkld 00

Predictor        Coef     SE Coef          T        P
Constant      3892261     3386089       1.15    0.456
wrkld 00      -19.686       5.153      -3.82    0.163

S = 510084      R-Sq = 93.6%     R-Sq(adj) = 87.2%

Analysis of Variance

Source            DF          SS          MS         F        P
Regression         1 3.79786E+12 3.79786E+12     14.60    0.163
Residual Error     1 2.60186E+11 2.60186E+11
Total              2 4.05804E+12
```

Plot: NOR versus Aircraft stabilized rate in 2000

```
         -
 nor 00b -                                                        *
         -
         -
 -7500000+
         -
         -
         -
         -                              *
 -1.0E+07+
         -
         -
         -
         -
 -1.3E+07+
         -    *
         -
           --+---------+---------+---------+---------+---------+----rate 00
          69.0      72.0      75.0      78.0      81.0      84.0
```

```
Slope = 45.1
```

Regression Analysis: NOR versus Aircraft stabilized rate in 2000

```
The regression equation is
nor 00b = -44168334 + 451069 rate 00

Predictor        Coef     SE Coef          T        P
Constant    -44168334       13109   -3369.42    0.000
rate 00        451069         170    2660.24    0.000

S = 1848        R-Sq = 100.0%    R-Sq(adj) = 100.0%

Analysis of Variance

Source            DF          SS          MS         F        P
Regression         1 2.41580E+13 2.41580E+13 7.077E+06    0.000
Residual Error     1     3413644     3413644
Total              2 2.41580E+13
```

Plot: NOR versus Aircraft norms in 2001

```
          -
  2000000+                                                       *
          -
 nor 01   -
          -
          -
        0+
          -
          -                               *
          -
          -
 -2000000+
          -
          -
          -
          -     *
 -4000000+
           +---------+---------+---------+---------+---------+------norms 01
      460000    480000    500000    520000    540000    560000

Slope = 50.9
```

Regression Analysis: NOR versus Aircraft norms in 2001

```
The regression equation is
nor 01 = -27203576 + 50.9 norms 01

Predictor         Coef     SE Coef          T        P
Constant    -27203576     1295910     -20.99    0.030
norms 01       50.885       2.486      20.47    0.031

S = 182660      R-Sq = 99.8%     R-Sq(adj) = 99.5%

Analysis of Variance

Source            DF           SS           MS         F        P
Regression         1 1.39827E+13 1.39827E+13    419.09    0.031
Residual Error     1 33364556822 33364556822
Total              2 1.40160E+13
```

Plot: NOR versus Aircraft workload projections in 2001

```
          -
  1500000+       *
          -
 nor 01a -
          -
          -
        0+
          -
          -                     *
          -
          -
 -1500000+
          -
          -
          -
          -                                            *
 -3000000+
           --------+---------+---------+---------+---------+--------wrkld 01
              420000    440000    460000    480000    500000
```

Slope = 45.7

Regression Analysis: NOR versus Aircraft workload projections in 2001

The regression equation is
nor 01a =20422612 - 45.7 wrkld 01

Predictor	Coef	SE Coef	T	P
Constant	20422612	122606	166.57	0.004
wrkld 01	-45.6929	0.2653	-172.24	0.004

S = 16981   R-Sq = 100.0%   R-Sq(adj) = 100.0%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	8.55414E+12	8.55414E+12	29665.06	0.004
Residual Error	1	288357337	288357337		
Total	2	8.55443E+12			

Plot: NOR versus Aircraft stabilized rate in 2001

```
         -                                                        *
         -
  3000000+
         -
 nor 01b -
         -
         -
        0+
         -                              *
         -
         -
         -
 -3000000+
         -
         -
         -
         -    *
           --------+---------+---------+---------+---------+--------rate 01
                84.0      87.5      91.0      94.5      98.0

Slope = 51.9
```

Regression Analysis: NOR versus Aircraft stabilized rate in 2001

```
The regression equation is
nor 01b = -48117199 + 519398 rate 01

Predictor        Coef     SE Coef          T        P
Constant    -48117199          75 -639239.21    0.000
rate 01        519398           1  633196.47    0.000

S = 10.61       R-Sq = 100.0%    R-Sq(adj) = 100.0%

Analysis of Variance

Source            DF          SS          MS          F        P
Regression         1 4.51723E+13 4.51723E+13 4.009E+11    0.000
Residual Error     1         113         113
Total              2 4.51723E+13
```

Plot: NOR versus Engine norms in 1999

```
 N NOR 99-
         -                                                        *
         -
  3000000+
         -
         -
         -
         -
  2000000+
         -
         -
         -
         -                             *
  1000000+
         -
         -  *
         -
           +---------+---------+---------+---------+---------+------Norms 99
      144000    150000    156000    162000    168000    174000
```

```
Slope =90.4
```

Regression Analysis: NOR versus Engine norms in 1999

```
The regression equation is
N NOR 99 = -12831086 + 90.4 Norms 99

Predictor        Coef     SE Coef          T        P
Constant    -12831086     5027841      -2.55    0.238
Norms 99        90.44       31.17       2.90    0.211

S = 708690      R-Sq = 89.4%     R-Sq(adj) = 78.8%

Analysis of Variance

Source            DF          SS          MS          F        P
Regression         1 4.22762E+12 4.22762E+12       8.42    0.211
Residual Error     1 5.02242E+11 5.02242E+11
Total              2 4.72986E+12
```

Plot: NOR versus Engine workload projections in 1999

```
         -   *
         -
  2100000+
         -
 W NOR 99-
         -
         -                                                     *
  1750000+
         -
         -
         -
         -
  1400000+
         -
         -
         -
         -                            *
           +---------+---------+---------+---------+---------+------Wrkld 99
       69000     72000     75000     78000     81000     84000

Slope = 27.3
```

Regression Analysis: NOR versus Engine workload projections in 1999

```
The regression equation is
W NOR 99 = 3822041 - 27.3 Wrkld 99

Predictor        Coef     SE Coef          T        P
Constant      3822041     5288881       0.72    0.602
Wrkld 99       -27.27       68.37      -0.40    0.758

S = 726292      R-Sq = 13.7%     R-Sq(adj) = 0.0%

Analysis of Variance

Source            DF          SS          MS         F        P
Regression         1 83926324329 83926324329      0.16    0.758
Residual Error     1 5.27500E+11 5.27500E+11
Total              2 6.11426E+11
```

Plot: NOR versus Engine stabilized rate in 1999

```
 R NOR 99-
         -
         -                                                         *
  2400000+
         -
         -
         -
         -
  1200000+                             *
         -
         -
         -
         -
        0+
         -
         -     *
         -
           --+---------+---------+---------+---------+---------+----Rate 99
            88.0      92.0      96.0     100.0     104.0     108.0
```

```
Slope = 16.0
```

Regression Analysis: NOR versus Engine stabilized rate in 1999

```
The regression equation is
R NOR 99 = -14698224 + 160749 Rate 99

Predictor        Coef     SE Coef          T        P
Constant    -14698224           0          *        *
Rate 99        160749           0          *        *

S = 0           R-Sq = 100.0%    R-Sq(adj) = 100.0%

Analysis of Variance

Source            DF          SS          MS          F        P
Regression         1 5.01010E+12 5.01010E+12          *        *
Residual Error     1           0           0
Total              2 5.01010E+12
```

Plot: NOR versus Engine norms in 2000

```
        -                                                        *
       0+
        -
N NOR 00-
        -
        -
-1000000+
        -                              *
        -
        -
        -
-2000000+
        -
        -
        -
        -   *
-3000000+
          ------+---------+---------+---------+---------+---------+Norms 00
           150000    156000    162000    168000    174000    180000
```

Slope = 92.3

Regression Analysis: NOR versus Engine norms in 2000

The regression equation is
N NOR 00 = -16410615 + 92.3 Norms 00

Predictor	Coef	SE Coef	T	P
Constant	-16410615	169733	-96.68	0.007
Norms 00	92.331	1.033	89.34	0.007

S = 23924   R-Sq = 100.0%   R-Sq(adj) = 100.0%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	4.56841E+12	4.56841E+12	7981.63	0.007
Residual Error	1	572365734	572365734		
Total	2	4.56898E+12			

Plot: NOR versus Engine workload projections in 2000

```
 W NOR 00-
         - *
         -
 -1200000+
         -
         -
         -
         -                           *
 -1300000+
         -
         -
         -
         -
 -1400000+
         -                                                        *
         -
         -
           ----+---------+---------+---------+---------+---------+--Wrkld 00
          108000    112000    116000    120000    124000    128000
```

```
Slope = 12.3
```

Regression Analysis: NOR versus Engine workload projections in 2000

```
The regression equation is
W NOR 00 = 160583 - 12.3 Wrkld 00

Predictor        Coef     SE Coef          T        P
Constant       160583      101077       1.59    0.358
Wrkld 00     -12.3423      0.8585     -14.38    0.044

S = 13365       R-Sq = 99.5%     R-Sq(adj) = 99.0%

Analysis of Variance

Source             DF          SS          MS         F        P
Regression          1 36917781264 36917781264    206.69    0.044
Residual Error      1   178618528   178618528
Total               2 37096399793
```

Plot: NOR versus Engine stabilized rate in 2000

```
         -                                                    *
         -
        0+
         -
 R NOR 00-
         -
         -
 -1200000+                             *
         -
         -
         -
         -
 -2400000+
         -
         -   *
         -
         -
           ----+---------+---------+---------+---------+---------+--Rate 00
              92.0      96.0     100.0     104.0     108.0     112.0
```

Slope = 16.3

Regression Analysis: NOR versus Engine stabilized rate in 2000

```
The regression equation is
R NOR 00 = -17862569 + 163691 Rate 00

Predictor        Coef     SE Coef          T        P
Constant    -17862569           0          *        *
Rate 00        163691           0          *        *

S = 0           R-Sq = 100.0%    R-Sq(adj) = 100.0%

Analysis of Variance

Source            DF          SS          MS         F        P
Regression         1 5.50136E+12 5.50136E+12         *        *
Residual Error     1           0           0
Total              2 5.50136E+12
```

Plot: NOR versus Engine norms in 2001

```
  1600000+
         -                                                      *
 N NOR 01-
         -
         -                              *
   800000+
         -
         -
         -
         -
        0+
         -
         -
         -
         -
  -800000+      *
         -
           --+---------+---------+---------+---------+---------+----Norms 01
        105000    110000    115000    120000    125000    130000
```

```
Slope = 94.1
```

Regression Analysis: NOR versus Engine norms in 2001

```
The regression equation is
N NOR 01 = -10598179 + 94.1 Norms 01

Predictor        Coef     SE Coef          T        P
Constant    -10598179     3620914      -2.93    0.210
Norms 01        94.11       30.45       3.09    0.199

S = 510376      R-Sq = 90.5%     R-Sq(adj) = 81.0%

Analysis of Variance

Source            DF          SS          MS         F        P
Regression         1 2.48751E+12 2.48751E+12      9.55    0.199
Residual Error     1 2.60484E+11 2.60484E+11
Total              2 2.74800E+12
```

Plot: NOR versus Engine workload projections in 2001

```
  1000000+
         -                            *
  W NOR 01-
         -
         -
   750000+
         -
         -
         -
         -
   500000+   *
         -
         -
         -
         -
   250000+
         -                                                       *
           --------+---------+---------+---------+---------+--------Wrkld 01
               70000     72500     75000     77500     80000
```

```
Slope = 23.1
```

Regression Analysis: NOR versus Engine workload projections in 2001

```
The regression equation is
W NOR 01 = 2295700 - 23.1 Wrkld 01

Predictor        Coef     SE Coef          T        P
Constant      2295700     4032213       0.57    0.671
Wrkld 01       -23.15       53.60      -0.43    0.740

S = 499566      R-Sq = 15.7%     R-Sq(adj) = 0.0%

Analysis of Variance

Source            DF          SS          MS         F        P
Regression         1 46539700653 46539700653      0.19    0.740
Residual Error     1 2.49567E+11 2.49567E+11
Total              2 2.96106E+11
```

Plot: NOR versus Engine stabilized rate in 2001

```
 R NOR 01-
        -                                                   *
        -
  2000000+
        -
        -
        -
        -
  1000000+                            *
        -
        -
        -
        -
        0+
        -
        -      *
        -
          --+---------+---------+---------+---------+---------+----Rate 01
          100.0     105.0     110.0     115.0     120.0     125.0

Slope = 11.8
```

Regression Analysis: NOR versus Engine stabilized rate in 2001

```
The regression equation is
R NOR 01 = -12443219 + 118510 Rate 01

Predictor        Coef     SE Coef          T        P
Constant    -12443219           3 -4.296E+06    0.000
Rate 01        118510           0 4646796.14    0.000

S = 0.4082      R-Sq = 100.0%    R-Sq(adj) = 100.0%

Analysis of Variance

Source            DF          SS          MS         F        P
Regression         1 3.59879E+12 3.59879E+12 2.159E+13    0.000
Residual Error     1           0           0
Total              2 3.59879E+12
```

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